COURSE OVERVIEW EE0200-4D
Practical Troubleshooting of Electrical Equipments & Control Circuits

Course Title
Practical Troubleshooting of Electrical Equipments & Control Circuits

Course Reference
EE0200-4D

Course Duration/Credits
Four days/2.4 CEUs/24 PDHs

Course Date/Venue

1	September 02-05, 2024	Club B Meeting Room, Ramada Plaza by Wyndham Istanbul City Center, Istanbul, Turkey
2	December 23-26, 2024	Boardroom 1, Elite Byblos Hotel Al Barsha, Sheikh Zayed Road, Dubai, UAE

Course Description

This practical and highly-interactive course includes various practical sessions and exercises. Theory learnt will be applied using our state-of-the art simulators.

No matter how complete or expensive an electrical system is, the components of the system begin to deteriorate as soon as they are installed and failure of some component in the system will ultimately result. If deterioration is not checked, it can cause electrical failures and malfunctions. In addition, load changes or circuit alterations may be made without overall design coordination, which can result in improper selection of equipment, or settings of protective devices, or wrong trip units installed in the circuits. There are certain definite and logical methods and procedures in locating the source of trouble on electrical equipment. Experience indicates that in most cases where the exact trouble spot is not determined, it is because the troubleshooter has not applied his or her knowledge properly.

Blown fuses, overload contacts, open contacts, short circuits, burned out coils, and grounds are responsible for most electrical circuit failures. These problems should be relatively easy to find and correct. Many of the more "sophisticated" systems fail because of some minor adjustment problem that requires more information than has been furnished to all the repair people. Records indicate that this type of failure is infrequent.

The larger and more complicated system usually fails for the same reasons as the smaller and less complicated system: dirty contacts, open circuits, blown fuses, burned out coils, faulty grounds, broken limit arms, or some other mechanical aspect relating to the electrical operation.

This course covers the troubleshooting of all types of apparatus and equipment found in the electrical power systems serving industrial and commercial facilities, large institutional complexes and office buildings, and utility type substations and generating plants. The course provides practical information on the troubleshooting of electrical equipment and control circuits for the maintenance personnel who install and care for such equipment.

The course utilizes a state-of-the-art Electrical Troubleshooting Simulator, where participants will actually troubleshoot electrical faults. The software will allow participants to operate the circuit, take meter readings, remove wires, replace components and other troubleshooting activities. Participants will actually solve multiple faults on a highly realistic circuit simulation of an electric motor consisting of numerous relays, switches, lights, solenoids, limit switches, reversing starter with overloads, push buttons, step down transformer, and safety switch. Further, multimeters, clamp-on meters, ammeters, megohmmeters, proximity voltage meters, hand-held oscilloscopes and other meters will be thoroughly discussed as plant electrical troubleshooting tools. This course concentrates on both safety and efficiency to achieve the ultimate goal of savings through the reduction of lost production time.

Course Objectives

Upon the successful completion of this course, each participant will be able to:-

- Apply various troubleshooting methods and procedures related to accurate wiring of circuits and connections
- Discuss the different troubleshooting instruments and tools associated to electrical equipments such as voltmeter, series ohmmeter, megger, and etc
- Characterize several devices, symbols, and circuits in accordance to wires and terminal numbering
- Recognize the aspects of three-phase motor starters through magnetic overload relay and typical starting methods
- Employ various procedures for troubleshooting AC motors and starters in line with motor terminal identification and connection diagram
- Determine the process for troubleshooting direct current machines such as direct current generator, right hand rule, electric generators and motors
- Discuss the power electronic components through several troubleshooting variable speed drives
- Identify the methods of troubleshooting switches, circuit breakers, and switchboards according to overloads and fault protection
- Implement the different procedures for troubleshooting control circuits and become aware of the element of ladder logic circuits

Who Should Attend

This course provides various troubleshooting techniques of electrical equipments and control circuits for electrical power managers, engineers, superintendents, supervisors, foremen, technicians and those who are involved in the design, engineering, operation, maintenance and control of the electric power system or anyone interested in obtaining a working knowledge and skill on troubleshooting electrical equipment and control circuits.

Course Certificate(s)

Internationally recognized certificates will be issued to all participants of the course who completed a minimum of 80% of the total tuition hours.

Certificate Accreditations

Certificates are accredited by the following international accreditation organizations:-

- The International Accreditors for Continuing Education and Training (IACET - USA)

  Haward Technology is an Authorized Training Provider by the International Accreditors for Continuing Education and Training (IACET), 2201 Cooperative Way, Suite 600, Herndon, VA 20171, USA. In obtaining this authority, Haward Technology has demonstrated that it complies with the **ANSI/IACET 2018-1 Standard** which is widely recognized as the standard of good practice internationally. As a result of our Authorized Provider membership status, Haward Technology is authorized to offer IACET CEUs for its programs that qualify under the **ANSI/IACET 2018-1 Standard**.

  Haward Technology's courses meet the professional certification and continuing education requirements for participants seeking **Continuing Education Units** (CEUs) in accordance with the rules & regulations of the International Accreditors for Continuing Education & Training (IACET). IACET is an international authority that evaluates programs according to strict, research-based criteria and guidelines. The CEU is an internationally accepted uniform unit of measurement in qualified courses of continuing education.

  Haward Technology Middle East will award **2.4 CEUs** (Continuing Education Units) or **24 PDHs** (Professional Development Hours) for participants who completed the total tuition hours of this program. One CEU is equivalent to ten Professional Development Hours (PDHs) or ten contact hours of the participation in and completion of Haward Technology programs. A permanent record of a participant's involvement and awarding of CEU will be maintained by Haward Technology. Haward Technology will provide a copy of the participant's CEU and PDH Transcript of Records upon request.

- British Accreditation Council (BAC)

  Haward Technology is accredited by the **British Accreditation Council** for **Independent Further and Higher Education** as an **International Centre**. BAC is the British accrediting body responsible for setting standards within independent further and higher education sector in the UK and overseas. As a BAC-accredited international centre, Haward Technology meets all of the international higher education criteria and standards set by BAC.

Accommodation

Accommodation is not included in the course fees. However, any accommodation required can be arranged at the time of booking.

Course Instructor(s)

This course will be conducted by the following instructor(s). However, we have the right to change the course instructor(s) prior to the course date and inform participants accordingly:

Mr. William Kruger, is a **Senior Electrical & Instrumentation Engineer** with over **30 years** of extensive experience with the **Oil & Gas** and **Power** industries. His specialization widely covers the areas of HV/MV **Cable** Splicing, Jointing, Inspection & Termination, **Power Cable** Standard & Testing, **Cable** Laying, **Insulated Power Cables**, **HV Cable Design**, Safety Integrity Level (**SIL**) Determination and Verification, Layers of Protection Analysis (**LOPA**), **Safety Instrumentation**, **Hazardous Area Classification**, **Electrical Reticulation** System, Programmable Logic Controller (**PLC**), Distributed Control System (**DCS**), **HV/LV** Equipment, **High Voltage Electrical Safety**, **LV & HV Electrical System**, **HV Equipments** Inspection & Maintenance, **HV Switchgear** Operation & Maintenance, **LV Distribution Switchgear & Equipment**, **Circuit Breakers & Switchgears**, Portable **Cables**, **Transformers**, Gas Insulated Substations (**GIS**), **HV Substation** Inspection & Reporting, **HV Cable Design**, **HV Electrical System** Commissioning, **HV Equipments** Inspection & Maintenance, Safety Integrity Level (**SIL**) Determination and Verification, Layers of Protection Analysis (**LOPA**), **Safety Instrumentation**, **Hazardous Area Classification**, **Electrical Reticulation** System, Programmable Logic Controller (**PLC**), **Electrical Safety**, **HV/LV/MV Switchgear**, Petroleum **Tanks Measurement** & **Meter Proving**, **Area** Classification & Selection of Equipment, General Instrumentation, **Process Control** for Industrial Applications, **Power System** Protection, **SEPAM 80 Protection** Relay, **LTMR** Relay, **Electrical Hazards** Assessment, **Electrical Safety**, **Electrical Hazards Assessment**, **Electrical Equipment**, **Personal Protective Equipment**, Lock-Out & Tag-Out (**LOTO**), Confined Workspaces, Power **Quality**, Power **Network**, Power **Distribution**, **Distribution Systems**, **Power Systems Control**, **Power Systems Security**, Power **Electronics**, Electrical **Substations**, **UPS** & **Battery System**, **Earthing & Grounding**, Power **Generation**, **Protective Systems**, **Electrical Generators**, **Power** & **Distribution Transformers**, **Electrical Motors**, **Switchgears**, **Transformers**, **AC** & **DC Drives**, **Variable Speed Drives** & **Generators** and **Generator Protection**, **Saftronic Precipitator Control Unit** Optimization, **Power Generation**, **Electrical** Engineering, **Electrical** Machines, **Electronic** Design, **Industrial Electronics**, **Uninterruptable Power Systems**, **Switchgear**, Swing Arm Radius Detection System, GPS Technology, **Electrical Equipment Circuits**, **Wiring & Testing**, **Electronic Circuits**, Electrostatic Discharge (**ESD**), **Electrical** Safety, **Electrical** Drawing, **Power Generation & Transmission**, **Power Distribution & Network**, **Protection Relays** and **Electrical** Troubleshooting. Further, he is also well-versed in MS Office, AutoCAD, Pastel, Home Design Pro and SARS E-Filing.

During his career life, Mr. Kruger has gained his expertise and thorough practical experience through handling challenging positions such as being the **Managing Director**, **Coal Mine General Manager**, **Electrical Engineer**, **Commissioning Engineer**, **Test Field Engineer**, **Instrumentation & Control Systems Engineer**, **Process Control Engineer**, **Automation Engineer**, **Field Instrument Engineer**, **Electrical Engineering Head**, **Electrical Commissioning Head**, **Electrical Maintenance Superintendent**, **Engineering Supervisor** and **Senior Technician** for various companies such as the Iscor Ltd, Sappi (Ngodwana) Ltd, Dart Mining and Electronics CC, Mine Radio Systems (Pty) Ltd, Kunye Mining Solutions (Pty) Ltd, Bakela Technical Services and Old Mutual.

Mr. Kruger has a **National Higher Diploma** in **Electrical Engineering**. Further, he is a **Certified Instructor/Trainer**, a **Certified Internal Verifier/ Assessor/Trainer** by the **Institute of Leadership and Management** (**ILM**) and has delivered numerous trainings, courses, workshops, seminars and conferences internationally.

Training Methodology

All our Courses are including **Hands-on Practical Sessions** using equipment, State-of-the-Art Simulators, Drawings, Case Studies, Videos and Exercises. The courses include the following training methodologies as a percentage of the total tuition hours:-

30% Lectures
20% Practical Workshops & Work Presentations
30% Hands-on Practical Exercises & Case Studies
20% Simulators (Hardware & Software) & Videos

In an unlikely event, the course instructor may modify the above training methodology before or during the course for technical reasons.

Course Fee

Istanbul	**US$ 5,000** per Delegate + **VAT**. This rate includes Participants Pack (Folder, Manual, Hand-outs, etc.), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.
Dubai	**US$ 4,500** per Delegate + **VAT**. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Course Program

The following program is planned for this course. However, the course director(s) may modify this program before or during the course for technical reasons with no prior notice to participants. Nevertheless, the course objectives will always be met:

Day 1

0730 – 0800	*Registration & Coffee*
0800 – 0815	*Welcome & Introduction*
0815 – 0830	***PRE-TEST***
0830 – 0930	***Troubleshooting Methods & Procedures*** *Basic Principles in Using a Drawing and Meter in Troubleshooting Circuits ● Checks for Circuit Continuity with Disconnected Supply ● Checks for Circuit Continuity with Live Supply ● Tests and Methods*
0930 – 0945	*Break*
0945 – 1100	***Troubleshooting Methods & Procedures (cont'd)*** *Testing Devices ● Circuits ● Accurate Wiring of Circuits and Connections ● Tests for Installation and Troubleshooting*
1100 – 1230	***Troubleshooting Instruments & Tools*** *D'Arsonval Meter Movement ● Voltmeter ● Series Ohmmeter ● Electrodynamometer ● Megger*
1230 – 1245	*Break*
1245 – 1420	***Troubleshooting Instruments & Tools (cont'd)*** *Clamp-On Ammeters • Infrared or Thermal Scanners ● Phase Sequence Indicator ● Rotation Tester ● Proximity Voltage Meters ● Hand-held Oscilloscopes*
1420 - 1430	***Recap***
1430	*Lunch & End of Day One*

Day 2

0730 – 0930	***Devices, Symbols & Circuits*** *Devices and Symbols ● Electrical Circuits ● Reading and Understanding Electrical Drawings ● Reading and Understanding Ladder Logic • Wires and Terminal Numbering ● Manual Control ● Semiautomatic Control ● Automatic Control*
0930 – 0945	*Break*
0945 – 1100	***Three-Phase Motor Starters*** *Motor Starters ● Reversing Control ● Definition of Terms ● Overload Protection • Overload Relay ● Magnetic Overload Relay ● Reduced-Voltage Starters ● Typical Starting Methods*
1100 – 1230	***Troubleshooting AC Motors & Starters*** *Fundamentals of Three-Phase AC Motors ● Fundamentals of Single-Phase AC Motors ● DC Motors ● Motor Enclosures ● Motor Terminal Identification and Connection Diagram ● Motor Rating and Insulation Types*
1230 – 1245	*Break*
1245 – 1420	***Troubleshooting AC Motors & Starters (cont'd)*** *Operating a Motor for Forward and Reverse Operation ● Motor Braking Methods ● Motor Testing ● Measurements Used for a Motor ● Motor Failures and Methods to Extend its Life ● Motor Control Trouble-Remedy Table ● Motor Starter Check Chart*
1420 - 1430	***Recap***
1430	*Lunch & End of Day Two*

Day 3

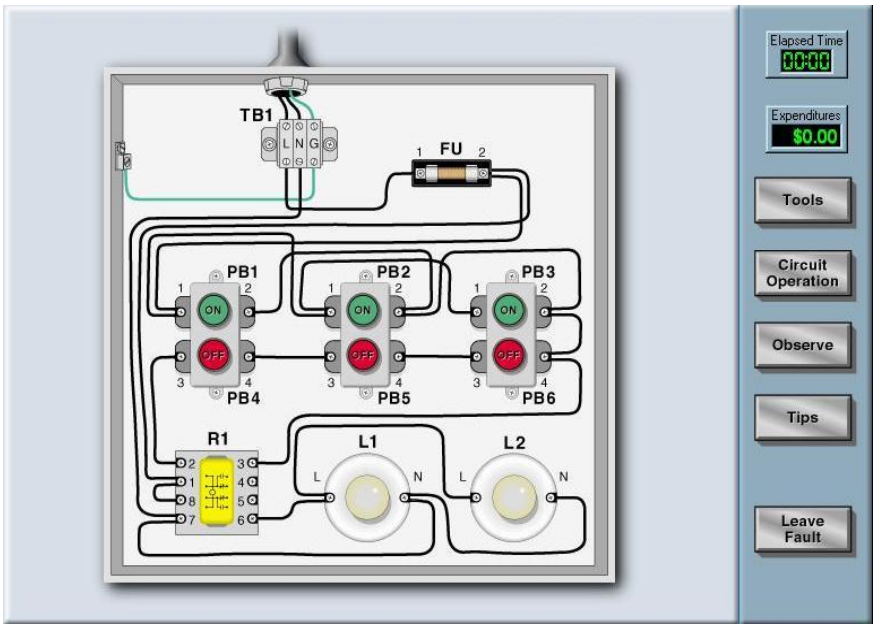
0730 – 0930	***Troubleshooting Direct Current Machines*** *Electric Generators and Motors ● Direct Current Generator ● Right-Hand Rule*
0930 – 0945	*Break*
0945 – 1100	***Troubleshooting Direct Current Machines (cont'd)*** *Voltage Values: Faraday's Law ● Direct Current Motor Principles ● Machine Components and Symbols ● Motor Types*
1100 – 1230	***Troubleshooting Variable Speed Drives*** *The Need for VSDs ● Basic VSD ● Power Electronic Components ● Electrical VSDs ● Power Electronic Rectifiers (AC/DC Converters) ● Gate-Commutated Inverters (DC/AC Converters)*
1230 – 1245	*Break*
1245 – 1420	***Troubleshooting Variable Speed Drives (cont'd)*** *Overall Protection and Diagnostics ● Installations and Commissioning ● Power Supply Connections and Earthing Requirements ● Precautions for Start/Stop Control of AC Drives ● Control Wiring VSDs ● Commissioning VSDs*
1420 - 1430	***Recap***
1430	*Lunch & End of Day Three*

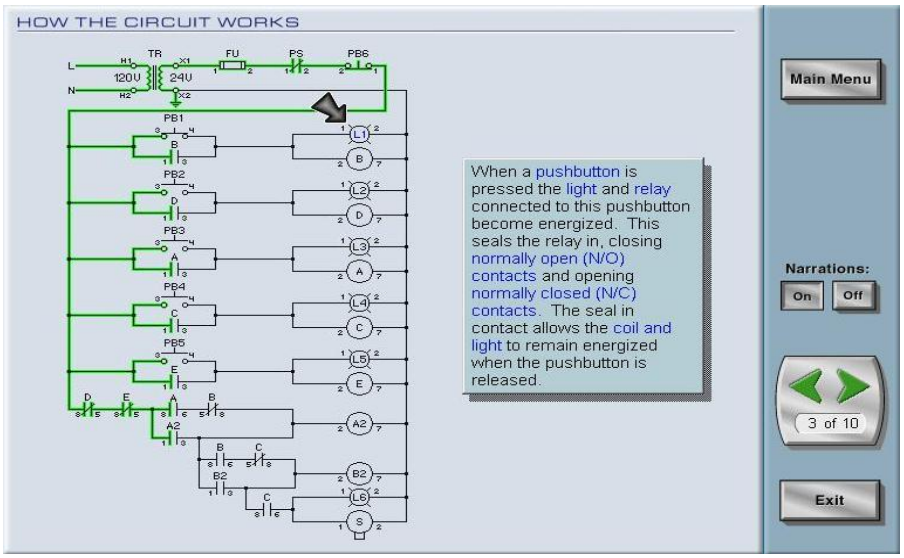
Day 4

0730 – 0930	***Troubleshooting Switches, Circuit Breakers & Switchboards*** *Switches and Circuit Breakers ● Overloads and Fault Protection*
0930 – 0945	*Break*
0945 – 1100	***Troubleshooting Switches, Circuit Breakers & Switchboards (cont'd)*** *Switchboards ● Motor Control Center*
1100 – 1230	***Troubleshooting Control Circuits*** *Basic Control Circuits ● Ladder Logic Circuits ● Two-Wire Control ● Three-Wire Control – Start/Stop ● Jog/Inch Circuits ● Sequence Start and Stop ● Automatic Sequence Starting*
1230 – 1245	*Break*
1245 – 1345	***Troubleshooting Control Circuits (cont'd)*** *Reversing Circuit ● Plug Stop and Anti-Plug Circuits ● Two-Speed Motor Control ● Overload Protection ● Troubleshooting Examples ● Troubleshooting Strategies ● Ladder Logic Design Exercise*
1345 - 1400	***Course Conclusion***
1400 – 1415	***POST-TEST***
1415 – 1430	*Presentation of Course Certificates*
1430	*Lunch & End of Course*

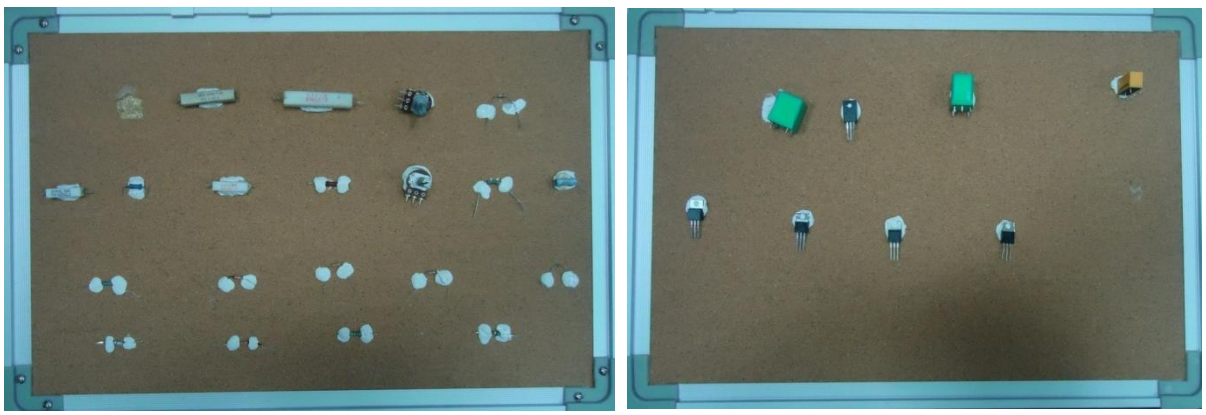
Simulators (Hands-on Practical Sessions)

Practical sessions will be organized during the course for delegates to practice the theory learnt. Delegates will be provided with an opportunity to carryout various exercises using our state-of-the-art "Simutech Troubleshooting Electrical Circuits V4.1" and "Haward Electric and Control Board" simulators".





Simutech Troubleshooting Electrical Circuits V4.1



Haward Electric and Control

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